Future Options

Option on Futures Introduction

- An option on futures gives the holder the right but not the obligation to buy or sell a futures at a specified price on a specified date.
- Options on futures are usually traded in an exchange.
- It is used to hedge against adverse changes in interest rates.
- The buyer normally can exercise the option on any business day (American style) prior to expiration by giving notice to the exchange.
- Option sellers (writers) receive a fixed premium upfront and in return are obligated to buy or sell the underlying asset at a specified price.
- Option writers are exposed to unlimited liability.

Option on Futures Introduction (Cont.)

- An investor who expected short-term interest rates to decline would also be expecting the price of the future contracts to increase. Thus, they might be inclined to purchase a 3-month Eurodollar futures call option to speculate on their belief.
- The advantage of option of a futures over options of a spot asset stems from the liquidity of futures contracts.
- Futures markets tend to be more liquid than underlying cash markets.
- Interest rate futures options are leveraged instruments.

Interest Rate Future Option

Valuation

- The price of an option on futures is quoted by the exchange.
- A model is mainly used for calculating sensitivities and managing risk.
- European option approximation
  - Options on futures are normally American options. One may use an European option to approximate.
  - The present value of a call option is given by

$$V(t) = N\tau D(L(t)\Phi(d_1) - K\Phi(d_2))$$

  - The present value of a put option is given by

$$V(t) = N\tau D\big(K\Phi(-d_2) - L(t)\Phi(-d_1)\big)$$

Interest Rate Future Option

Valuation (Cont.)

- where
  - t - the valuation date,
  - $L(t) = 100 - Y(t; T, T_E) + C$ – the forward rate; C is used to match market future price.
  - K – the strike
  - N – the notional
  - τ – the day count fraction for the forward period $[T, T_E]$
  - T – the maturity of the future contract and also the start date of forward period
  - T_E – the end date of the forward period
  - $D = D(t, T)$ – the discount factor
  - Φ – the accumulative normal distribution function
  - $d_{1,2} = \left(\ln\left(\frac{L}{K}\right) \pm 0.5\sigma^2 (T - t)\right) / (\sigma\sqrt{T - t})$

Valuation (Cont.)

- American option
  - Price options on futures as American options
  - Tree, PDE or lattice can be used to price an American option
  - Given options on futures are simple products, we use Black Scholes dynamics plus binomial tree to price an American option on futures.

Interest Rate Future Option

Example

Option specification		Underlying future specification	
Quote Price	0.05	Contract Size	10000
Trade Date	11/23/2016	First Delivery Date	5/30/2017
Option Maturity Date	6/19/2017	Last Delivery Date	6/30/2017
Settlement Amount	-62500	Future Maturity Date	6/19/2017
Settlement Date	11/23/2016	Tenor	3M
Strike	98.75	Future Ticker	EDM17
Option Ticker	EDM17P 98.75	Future Ticker Size	100
Call Put	Put	Number of Contract	500
Currency	USD		
Buy Sell	Buy		

Reference:
https://finpricing.com/lib/EqRainbow.html